CHAPTER 2—ADEQUACY OF THE AMOUNT OF RESEARCH SPACE AND ITS CONDITION

HIGHLIGHTS

- In light of their current research commitments, more than half of all institutions reported inadequate amounts of research space in every science and engineering field except mathematics, where 44 percent of the institutions indicated that their research space was inadequate (table 2-1).
- In order to meet their current research commitments, the research-performing institutions reported that they needed an additional 28.5 million net assignable square feet of science and engineering research space, or 20 percent more than they currently have (tables 2-2 and 2-3).
- Eighteen percent of all S&E research space (26 million NASF) was considered to require major renovation. An additional 5 percent of all S&E research space (7 million NASF) was considered to require replacement (table 2-4).
- Since 1988, the amount of research space requiring major renovation or replacement has increased in 11 of the 12 S&E fields included in the survey. Five of these fields (the social sciences; the medical sciences outside medical schools; the earth, atmospheric, and ocean sciences; the agricultural sciences; and the biological sciences outside medical schools) have experienced a 100-percent or more increase in the amount of research space in this condition (table 2-5).

INTRODUCTION

Information focused solely on the amount of science and engineering research space and its growth or decline over time is insufficient for understanding whether there is enough space to conduct research in general, and whether the condition of that space is suitable for conducting particularly sophisticated research. Respondents' assessments of both the quantity and quality of existing research space at their institutions from 1988–98 are examined in this chapter.

Respondents were asked to rate the adequacy of the amount of research space in each field at their institution by choosing one of the following categories (see Item 2 of the survey in Appendix C):

A Adequate amount of space: sufficient to support all the needs of your current S&E research program commitments in the field;

B Inadequate amount of space: not sufficient to support the needs of your current S&E research program commitments in the field; or nonexistent, but needed; or

NA Not applicable or no space needed in this field.

They were also asked to report in either net assignable square feet or in percents the amount of additional space needed to support current program commitments.

For each field, respondents indicated the condition of research space by reporting the percentage of space falling into one of the following categories (see Item 3 of the survey in Appendix C):

A Suitable for the most scientifically competitive research in the field;

B Effective for most levels of research in the field, but may need limited repair/renovation;

C Requires major renovation to be used effectively;

D Requires replacement; or

NA Not applicable or no research space in that field.

Measures of the adequacy of the amount of S&E research space and the condition of this space in each S&E field are based upon the assessments of several different individuals, including the survey coordinator at the institution, as well as deans and other administrators. These questions elicit more subjective responses than do other survey items.

Tables that analyze differences among S&E fields have been limited to only those institutions that had research space or reported a need for additional research space in those fields.

Findings

Adequacy of the Amount of S&E Research Space for Current Research Commitments

Institutions assessed the adequacy of the amount of science and engineering research space for each field for which they had research space. They assessed this space relative to their current research commitments. At least half of all institutions reported inadequate amounts of space in every field except mathematics, where 44 percent of the institutions indicated that their research space was inadequate (table 2-1). Regardless of institution type, the amount of existing S&E research space in every field was rated as inadequate by 40 percent or more of the institutions that had space in that field.

In four fields, more than 70 percent of the top 100 institutions indicated that the amount of existing research space was inadequate to meet their current research commitments. These fields and the percent of institutions reporting inadequate amounts of space are as follows:

- In engineering, 78 percent of the top 100 institutions reported that their existing research space was inadequate;
- In the biological sciences outside medical schools, 74 reported that their research space was inadequate;
- In the medical sciences in medical schools, 73 percent reported that their research space was inadequate; and
- In the physical sciences, 71 percent reported that their research space was inadequate.

Table 2-1. Percentage of institutions reporting inadequate amounts of science and engineering research space by institution type and field: 1998

Field	Total	Institution type		
		Doctorate-granting		
		Top 100 in research expenditures	Other	Nondoctorate-granting
Any field	83	92	80	83
Biological sciences—				
inside medical schools	70	62	78	--
outside medical schools	64	74	56	67
Physical sciences	64	71	55	69
Psychology	51	59	56	45
Social sciences	61	65	60	59
Mathematics	44	47	41	45
Computer sciences	56	63	47	60
Earth, atmospheric, and ocean sciences	62	61	61	63
Engineering	60	78	52	54
Agricultural sciences	55	65	53	47
Medical sciences—				
inside medical schools	67	73	62	--
outside medical schools	54	68	48	51

KEY: -- = number of institutions with nonmissing data less than 5. These institutions are included in the total.

NOTE: Includes only institutions that reported existing and/or needed research space in that field.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

In four fields, 60 percent or more of other doctorate-granting institutions indicated the amount of existing research space they had was inadequate for meeting their current research commitments. These fields and the percent of institutions reporting inadequate amounts of space are as follows:

- In the biological sciences in medical schools, 78 percent of other doctorate-granting institutions reported that their existing research space was inadequate;
- In the medical sciences in medical schools, 62 percent reported that their research space was inadequate;
- In the earth, atmospheric, and ocean sciences, 61 percent reported that their research space was inadequate; and
- In the social sciences, 60 percent reported that their research space was inadequate.

Finally, in four fields, 60 percent or more of nondoctorate-granting institutions reported that the amount of research space was inadequate for their current research commitments. These fields and the percent of institutions reporting inadequate amounts of space are as follows:

- In the physical sciences, 69 percent of nondoctorate-granting institutions reported that their research space was inadequate;
- In the biological sciences outside medical schools, 67 percent reported that their research space was inadequate;
- In the earth, atmospheric, and ocean sciences, 63 percent reported that their research space was inadequate; and
- In the computer sciences, 60 percent reported that their research space was inadequate.

Overall, a larger proportion of top 100 institutions (92 percent) reported inadequate amounts of research space in at least one field than did other doctorate-granting institutions (80 percent) and nondoctorate-granting institutions (83 percent). In engineering an appreciably larger proportion of top 100 institutions (78 percent) reported inadequate amounts of research space than either other doctorate-granting institutions (52 percent) or nondoctorate-granting institutions (54 percent).

Need for Additional S&E Research Space

The research-performing institutions reported that they needed an additional 28.5 million net assignable square feet of S&E research space, or 20 percent more than they had in order to meet their research commitments. The amount and proportion of need varied by field (table 2-2). Mathematics needed the least amount of additional research space (0.2 million NASF), while the biological sciences outside medical schools needed the most (4.8 million NASF). Other fields needing more than 2 million additional NASF of research space include:

- Engineering (4.0 million NASF);
- The medical sciences in medical schools (4.0 million NASF);
- The physical sciences (3.7 million NASF);

Table 2-2. Amount and percentage of total science and engineering (S&E) research space needed by field: 1998

Field	Total S&E research NASF	Additional NASF needed	Percentage needed
	NASF in millions		
Total	143	28.5	20
Biological sciences—			
inside medical schools	12	2.5	21
outside medical schools	19	4.8	25
Physical sciences	18	3.7	20
Psychology	3	0.7	25
Social sciences	5	1.3	26
Mathematics	1	0.2	24
Computer sciences	2	0.8	40
Earth, atmospheric, and			
ocean sciences	8	1.5	20
Engineering	23	4.0	17
Agricultural sciences	25	2.4	10
Medical sciences—			
inside medical schools	18	4.0	22
outside medical schools	7	1.9	27
Other sciences	3	0.6	21

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. Includes only institutions that reported existing and/or needed research space in that field.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- The biological sciences in medical schools (2.5 million NASF); and
- The agricultural sciences (2.4 million NASF).

A slightly different picture emerges when institutions' need for additional space is assessed as a proportion of their current amount of space. The agricultural sciences needed the smallest relative increment in research space (10 percent), while the computer sciences needed the largest relative increment (40 percent).

This need for space was not distributed equally across institution types (table 2-3). The top 100 institutions had the smallest relative need for additional research space (18 percent more), but they needed the greatest amount of space (18.6 million NASF). By contrast, the nondoctorate-granting institutions had the greatest relative need for additional research space (42 percent more), but needed the least amount of space (2.9 million NASF). The other doctorate-granting institutions fell in between. They needed 20 percent more space or 6.9 million NASF.

Condition of S&E Research Space

Over a third (39 percent or 56 million NASF) of the S&E research space at research-performing institutions was rated as "suitable for the most scientifically competitive research." The proportion of research space in this condition did not differ among the different types of research-performing institutions. The top 100 institutions rated 39 percent or 39 million NASF of their research space this way. Similarly, other doctorate-granting institutions reported that 41 percent or 14 million NASF of their research space was in the highest quality condition, and the nondoctorate-granting institutions reported that 32 percent or 2 million NASF of their research space was in this condition (table 2-4).

The research-performing colleges and universities classified a total of 18 percent (26 million NASF) of their S&E research space as requiring major renovation. The proportion of research space requiring renovation was greater at the top 100 institutions than at other doctorate-granting institutions (19 percent or 19 million NASF

Table 2-3. Amount and percentage of total science and engineering (S&E) research space needed by institution type: 1998

Institution type	Total S&E research NASF	Additional NASF needed	Percentage needed
	NASF in millions		
Total	143	28.5	20
Doctorate-granting	136	26	19
Top 100 in research expenditures	101	19	18
Other	35	7	20
Nondoctorate-granting	7	3	42

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 2-4. Institutional assessment of the quality and condition of science and engineering research space by institution type: 1998

Institution type	Suitable for the most scientifically competitive research in the field	Effective for most levels of research	Requires major renovation	Requires replacement
	Percentage of space			
Total	39	38	18	5
Doctorate-granting	40	38	18	5
Top 100 in research expenditures	39	37	19	5
Other	41	41	15	4
Nondoctorate-granting	32	37	26	5

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

compared with 15 percent or 5 million NASF). Nondoctorate institutions reported that 26 percent of their research space required major renovation.

There was general consistency among the different types of institutions regarding the proportion of S&E research space requiring replacement: 5 percent of the S&E research space at the top 100 and nondoctorate-granting institutions (5 million and 0.4 million NASF, respectively) was assessed as needing replacement, and 4 percent of S&E research space at other doctorate-granting institutions (1 million NASF) needed replacement.

Amount of S&E Research Space in Each Field Requiring Either Major Renovation or Replacement

Research-performing institutions reported 33.0 million NASF of S&E research space in need of major renovation or replacement in 1998. This represents almost one quarter (23 percent) of all S&E research space. The amount of research space in this condition has increased continuously since 1988, when 17.7 million NASF (16 percent) of all S&E research space needed major renovation or replacement.

Consistent with all previous surveys, in 1998, the agricultural sciences was again the field with the greatest amount of research space in need of major renovation or replacement. Of the 25 million NASF of S&E research space in the agricultural sciences (table 1-6), almost a third (7.5 million NASF or 30 percent) was assessed as requiring major renovation or replacement (table 2-5). This relatively large need is concentrated in a small number of institutions. Only 16 percent of all research-performing institutions have research space in the agricultural sciences (table 1-5), and more than half of these institutions (55 percent) reported inadequate research space in this field (table 2-1).

At the time of the survey, the research-performing institutions indicated that more than 3 million NASF of research space in four other fields required major renovation or replacement:

- The biological sciences outside of medical schools contained 4.8 million NASF in need of major renovation or replacement;
- The medical sciences in medical schools contained 4.6 million NASF of research space in this condition;
- Engineering contained 4.3 million NASF; and
- The physical sciences contained 3.9 million NASF.

Since 1988, the amount of research space requiring major renovation or replacement has increased in all but one S&E field (mathematics). Five fields have experienced an increase of 100 percent or more in the amount of research space in this condition over the decade:[15]

- The social sciences have experienced a 147-percent increase in research space in need of renovation or replacement (from 0.30 million NASF to 0.74 million NASF);
- The medical sciences outside medical schools have experienced a 125-percent increase in research space in this condition (from 0.8 million NASF to 1.8 million NASF);
- The earth, atmospheric, and ocean sciences have experienced a 111-percent increase (from 0.9 million NASF to 1.9 million NASF);
- The agricultural sciences have experienced a 108-percent increase (from 3.6 million NASF to 7.5 million NASF); and
- The biological sciences outside medical schools have experienced a 100-percent increase (from 2.4 million NASF to 4.8 million NASF).

Two other fields have experienced a near doubling of research space in need of major renovation or replacement since 1988. In engineering, research space in this condition grew from 2.2 million NASF to 4.3 million NASF (a 95-percent increase), while research space in this condition in the medical sciences in medical schools grew from 2.4 million NASF to 4.6 million NASF (a 92-percent increase).

[15] Data in table 2-5 have been rounded to one decimal place. In order to calculate meaningful percent changes over time, data in the text for some fields are presented as rounded to the second decimal place.

Table 2-5. Trends in the amount of science and engineering research space requiring major renovation or replacement by field: 1988–98

Field	1988	1990	1992	1994	1996	1998
	NASF in millions					
Total	17.7	18.0	19.4	21.7	25.2	33.0
Biological sciences—						
inside medical schools	1.0	1.2	1.6	1.6	1.6	1.9
outside medical schools	2.4	2.5	2.6	3.2	3.4	4.8
Physical sciences	2.9	2.7	2.4	3.1	3.4	3.9
Psychology	0.4	0.4	0.3	0.4	0.4	0.6
Social sciences	0.3	0.3	0.4	0.3	0.5	0.7
Mathematics	0.1	0.1	0.1	0.1	0.1	0.1
Computer sciences	0.2	0.1	0.1	0.1	0.2	0.3
Earth, atmospheric, and						
ocean sciences	0.9	0.9	0.8	1.3	1.3	1.9
Engineering	2.2	2.6	2.3	3.2	4.0	4.3
Agricultural sciences	3.6	4.6	5.2	4.4	5.3	7.5
Medical sciences—						
inside medical schools	2.4	1.9	2.7	2.9	3.6	4.6
outside medical schools	0.8	0.9	1.0	1.0	1.5	1.8

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. The total includes other sciences.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Between the last survey (1996) and the current one, the amount of research space requiring major renovation or replacement increased by 40 percent or more in six fields:[16]

- In the computer sciences, it increased by 100 percent (from 0.16 million NASF to 0.32 million NASF);
- In psychology, it increased by 55 percent (from 0.40 million NASF to 0.62 million NASF);
- In the social sciences, it increased by 48 percent (from 0.50 million NASF to 0.74 million NASF);
- In the earth, atmospheric, and ocean sciences, it increased by 46 percent (from 1.3 million NASF to 1.9 million NASF);
- In the agricultural sciences, it increased by 42 percent (from 5.3 million NASF to 7.5 million NASF); and
- In the biological sciences outside medical schools, it increased by 41 percent (from 3.4 million NASF to 4.8 million NASF).

[16] Ibid.